Short term cover crops increase wheat yields in southern Queensland.

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Abstract

Erosion following skip-row sorghum caused by summer storms in 2004 prompted an investigation as to whether a cover crop could be grown to protect the land without adverse impact on the subsequent winter crop.

Four replicated trials and 20 within paddock comparisons were conducted in 2004/5 and 2005/6. Cover crops were planted in spring then either sprayed out before flowering or taken through to harvest. Results showed white French millet (*Panicum milliaceum*) to be the species most efficient at producing ground cover from available water. Stored soil water, at the time of subsequent winter crop planting was generally increased following a sprayed out cover crop. Winter crop establishment was also improved. Wheat yields increased in 11 out of 12 comparisons, in 2005, with an average improvement of 0.15 t/ha. Taking a millet cover crop through to harvest led to a yield deficit in the subsequent winter crop but not of the extent WUE calculations would suggest.

These results have shown that growing a millet cover crop can have both economic and environmental benefits.

Key Words

Cover crops, ground cover, white French millet, wheat.

Introduction

Wheat growers in the North-East grains region of Australia often use a rotation to a summer crop as a method of reducing disease and pest loads and controlling weeds. In the Goondiwindi district in Southern Queensland and Northern NSW to rotate to a summer crop often involves a 12 months fallow to a sorghum crop then another long 13 month fallow from the sorghum crop (harvested in March/April) back to Wheat, planted in May. Growers have found that this rotation can leave inadequate stubble loads during the Jan-Feb-March storm season during the second long fallow and have experienced soil loss during intense rain events. The problem is exacerbated if the sorghum has been planted in a skip row configuration a practice increasingly adopted by farmers wanting to minimise the chance of sorghum crop failure (Routley *et al.* 2003). Cover cropping during this fallow is a possible solution to this problem

Requirements for such a cover crop would be:

- Provide adequate stubble cover during the summer storm season.
- It would not disrupt the disease and weed break.
- Be finished early enough to allow adequate soil water accumulation before the wheat crop.
- Easy and cheap to establish.

Spring planted millets (White French Millet (Proso Millet, *Panicum milliaceum*), Japanese millet (*Echinochloa esculenta*) and Drawf Setaria (foxtail millet, *Setaria italica*) were proposed as a likely candidate crops. The use of cover crops has been widely used overseas (Scopel *et al.* 2005) and in the vegetable & organic industry in Australia (NSW DPI, 2004).

This paper presents the results of trials set up to investigate the use of crops grown specifically to produce ground cover, in the Goondiwindi district in 2004 and 2005 and the effects on subsequent winter crops.

Methods

The results reported are those from a total of 24 trials. These included 3 replicated (6 reps) trials, a species comparison trial (5 species and a fallow comparison at one site) and 20 non-replicated sites where farmers had left an unplanted strip in the middle of a paddock otherwise planted to a cover crop. All operations were performed using commercial planters and spray rigs. Treatments were created by leaving an unplanted strip "fallow", spraying-out the cover crop with Glyphosate or leaving the cover crop to mature.

Cover crops mostly of white French millet were sown in September 2004, September 2005 or November 2005. These crops were then either killed 35 – 72 days later or left to mature (87 – 105 days). All Soil water sampling was performed from the middle of the skip of the previous sorghum crop. Other data was collected no less than 5 metres from the edge of the plots.

Soils varied across the sites but could all be loosely described as "brigalow" cracking clays ranging in colour from red to dark grey. Sites were sampled in early May in both 2005 and 2006 to measure conditions at the optimum time for winter crop planting. Not all sites were planted to winter crop and some assessments were not performed at all sites.

Results

Ground cover

Ground cover increased at all sites compared to the fallow control. Levels of ground cover at most sites were generally sufficient to protect the land from erosion (Freebairn, 2004). The level of cover achieved depended on establishment and vigour of the cover crop, time and conditions at planting, time of spray-out and subsequent paddock operations.

Over the two seasons white French millet tended to be the most efficient species at turning water into ground cover (Figure 1). The trend-line shown is for white French millet. Comparisons should be viewed with caution as the data set for other species was low; however, all points fall below the WFM trend-line. Figure 2 shows the strong link between the level of ground cover achieved and cover crop establishment.

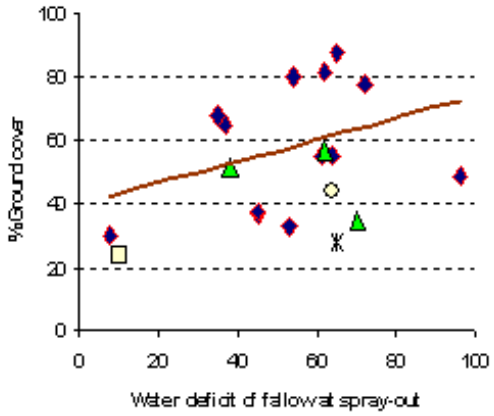


Figure 1. Species effect on ground cover

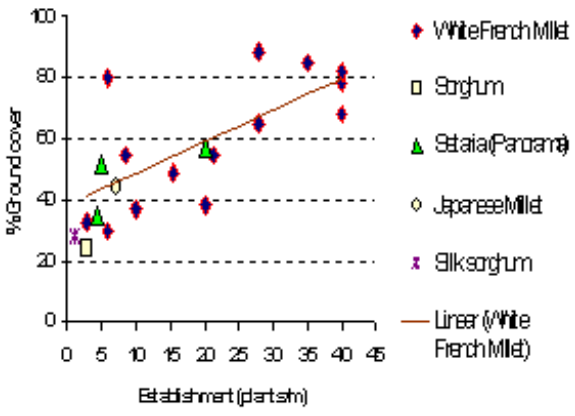


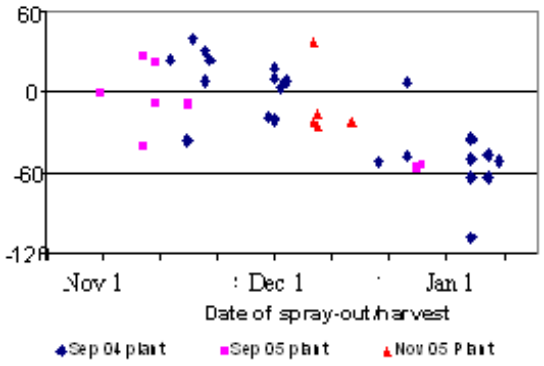
Figure 2. Establishment effect on ground cover

production efficiency **production**

Water balance

By winter crop planting time (April/May) paddocks where a cover crop had been killed in November or early December showed little if any soil water deficit compared to the fallow control area (Figure 3). Many of the cover crop paddocks appeared to have increased soil water levels. Where the millet crop had been allowed to go through to harvest there was an average soil water deficit of 49 mm. In the 2 seasons of these trials the Goondiwindi rainfall over the fallow period (Dec 1 – April 30) has been 176 and 209 mm compared to the long term average of 311 mm. It could be assumed that had rainfall been closer to the long term average that water deficits at winter crop planting would have been further reduced or eliminated.

In both seasons the surface soil layer (0-15 cm) under sprayed-out cover crops contained more water than fallowed sections of the paddocks (Figures 4). 16 of 19 sites where the cover crop was sprayed out before December 3 exhibited this increase in surface soil water. Mid-December spray-out or harvest resulted in inadequate rainfall to replenish soil water stocks prior to May.



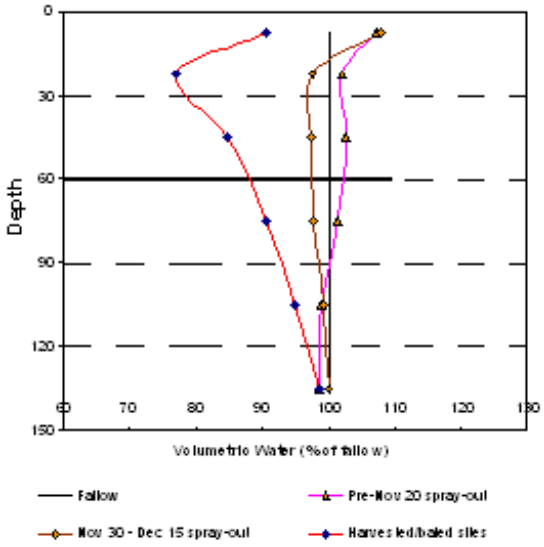


Figure 3. Effect of cover crop on soil water balance (mm) relative to fallow at winter crop planting.

Figure 4. Soil water vs depth at winter crop planting

Winter crop establishment

Establishment was generally higher where a cover crop had been sown than in the fallow area. The greatest improvement in establishment was under the early sprayed out cover crops (Table 1).

Table 1: Establishment of winter crops improves following a cover crop.

Mean no. of seedlings/m Cover crop	Mean no. of seedlings/m Fallow	% of fallow establishment	No. of sites increased/total sites

November Spray-out sites	26.0	20.6	158	9/10
December Spray-out sites	29.6	28.5	106	5/8
Harvested/Baled sites	26.8	25.8	109	3/4

Figure 5 shows how improvements in winter crop establishment were most pronounced at sites where establishment was poor under the fallow treatment. ie. Under harsh conditions a cover crop aided crop establishment.

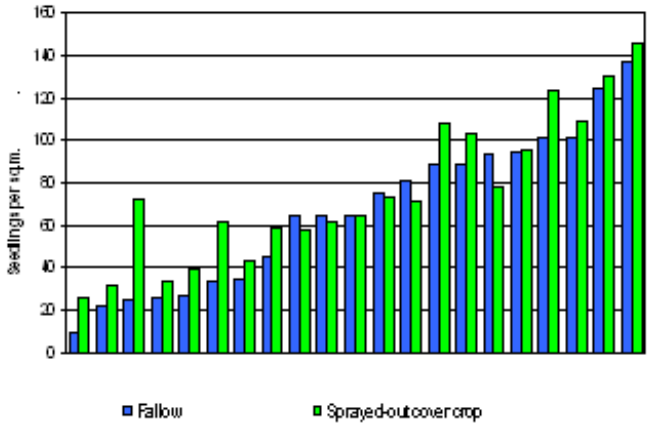


Figure 5: Winter crop establishment (seedlings per sqm) improved by cover crops

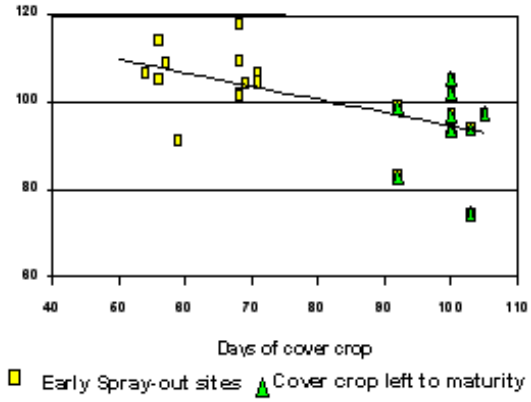


Figure 6: Effect of cover crop on yield (% of fallow) of subsequent winter cereal in 2005

Winter crop growth and yield

When writing this report only the 2005 wheat crops had been harvested (Figure 6). Sprayed-out cover crops were followed by a winter crop yield improvement in 11 of 12 comparisons. The average yield improvement where the cover crop had been sprayed out before day 72 was 6% or 0.15 t/ha. The maximum increase was 18% or 0.6 t/ha. For crops sown in May the average yield increase rose to 0.18 t/ha. In two of the replicated trials the yield increases were statistically significant.

Where the cover crop was left to mature there was a decreased yield at 8 out of 10 sites (the exceptions being July planted crops which yielded poorly even on fallow ground). The maximum yield decrease was of 26% or 0.75 t/ha while the average decrease compared to the fallow areas was 6% or 0.14 t/ha. Where the wheat crop was sown in May the average yield decrease was 0.24 t/ha. Water use efficiency data suggests that where the cover crop had been left to mature the average yield deficit should have been 0.75 tonnes/ha whereas the actual average deficit was only 1/3 of this amount.

Other effects of cover crops seen

- No sign of Fusarium infection in sampled millet cover crops and no increase in Crown rot in wheat stalks following a cover crop were observed.
- Protection from erosion - At some of the sites minor erosion was seen in fallow areas

- Weed suppression - Proliferation of weeds especially fleabane was seen in bare fallows. Very few weeds were seen where a good cover crop had been established.
- Healthier soil biology – Higher VAM levels associated with improved crop vigour at some sites
- Nitrogen tie-up in cover crop residue

Economics

Growing a millet cover crop was estimated to add $20 machinery costs and $34 for seed, fertiliser and herbicide. However at least one fallow spray is saved leaving a net cost of $42/ha. The average yield increase following a sprayed out cover crop for 2005 wheat was 0.15 t/ha. At a price of $180/tonne this is an extra return of $27/ha. Leaving a net cost of growing the cover crop at $15/ha.

Where farmers chose to take the millet cover crops through to harvest, yields averaged about 2.0 t/ha, giving gross margins of over $200/ha. The average yield decrease of the subsequent wheat crop for crops sown in May was 0.24 t/ha (approx. $43) compared to the traditional long fallow, leaving farmers who chose this option well ahead. The flexibility to be able to choose to take a cover crop through to harvest was valued highly by most of the farmers and agronomists involved. That the decision of whether or not the crop should be sprayed-out can be delayed until early December, 4 -5 weeks before harvest yet still have a positive effect on wheat yield make it even more valuable.

Conclusion

These results show that white French millet cover crop sown in September and sprayed out in November can produce ground cover levels that will protect against erosion and do not have a deleterious effect on the subsequent winter crop. A November spray-out gives enough time for soil water to be replenished before winter crop planting. Yield increases to the winter crops seen in these trials partially compensate for the cost of establishing the cover crop.

References

Routley, R. , Broad, I. , McLean, G. , Whish, J. , Hammer, G. (2003)The effect of row configuration on yield reliability in grain sorghum: I. Yield, water use efficiency and soil water extraction. Solutions for a better environment: Proceedings of the 11th Australian Agronomy Conference, Geelong, Victoria, Australia, 2-6 February 2003, pp.?0-4, 4 ref.

Scopel, E. , Findeling, A. , Chavez Guerra, E. , Corbeels, M. (2005) Impact of direct sowing mulch-based cropping systems on soil carbon, soil erosion and maize yield. Agronomy for Sustainable Development, Vol.?25, No.?4, pp.?425-432

NSW Department of Primary Industries (2004) Agnote DPI 327. Protect your land – use cover crops.

Freebairn, D. (2004) Erosion control. Natural Resource Management 2004 Vol.?7, No.?1, pp.?8-13